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A SIMPLE BASIC PROGRAM TO GENERATE VALUES FOR VARIABLE-INTERVAL SCHEDULES OF REINFORCEMENT

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A BASIC program to generate values for variable-interval (VI) schedules of reinforcement is presented. A VI schedule should provide access to reinforcement with a constant probability over a time horizon. If the values in a VI schedule are calculated from an arithmetic progression, the probability of reinforcement is positively correlated with the time since the last reinforcer was delivered. Fleshler and Hoffman (1962) developed an iterative equation to calculate VI schedule values so that the probability of reinforcement remains constant. This easy-to-use program generates VI schedule values according to the Fleshler and Hoffman equation, randomizes the values, and saves the values in ASCII to a disk file.

DESCRIPTORS: variable-interval schedules, computer programs, BASIC

The variable-interval (VI) schedule of reinforcement arranges response-dependent reinforcement at time intervals that vary in a near-random manner but have an overall mean interval value (Ferster & Skinner, 1957). The mean interval value is often expressed in seconds, such as a VI 30-s schedule in which the intervals between reinforcements vary, but the mean interval value is 30 s. Because reinforcement on a VI schedule is conjointly response contingent and time contingent and is near random in providing access to reinforcement, behavior subjected to a VI schedule seldom acquires discriminative properties. Rather, the rate at which reinforcement is delivered acquires discriminative properties. Thus, behavior subjected to a VI schedule is generally characterized by steady rates. In contrast, passage of time makes the delivery of reinforcement more probable and often acquires discriminative properties on a fixed-interval (FI) schedule. Similarly, behavior maintained by fixed-ratio (FR) and variable-ratio (VR) schedules often acquires discriminative properties because the probability of reinforcement varies directly with response rate.

VI schedules have been used in applied behavior analysis research in which variation in reinforcement density is the primary independent variable. Examples of this research include investment decision making and behavioral contrast (Hantula, 1990), behavioral momentum (Mace et al., 1990), and applications of the matching law (Herrnstein, 1970) to self-injury (McDowell, 1981), reducing inappropriate behaviors (Myerson & Hale, 1984), and social behavior (Conger & Killeen, 1974).

Ideally, a VI schedule of reinforcement is comprised of an infinite range of interval values with no correlation between time of the last reinforcement and time of the next reinforcement. Because an infinite range of values is unavailable, a smaller range of interval values, called the number of steps, is generally selected. After a mean interval value for a VI reinforcement schedule and the number of steps in the schedule are selected, the interval values may be calculated.

Although calculation of VI values according to an arithmetic progression (e.g., a VI 30-s schedule with intervals of 0, 10, 20, 30, 40, 50, 60 s) is convenient, this practice can interfere with the randomness of reinforcement. Fleshler and Hoffman (1962) showed that the probability of reinforcement increases as the time since the last reinforcement increases on a VI schedule with values derived from an arithmetic progression. Thus, there is a correlation between the time of the last reinforcement and the time of the next reinforcement. In contrast, with a true VI schedule the probability

I thank Barbara West for her comments on this program. A compiled version of this program that will run on an IBM-PC® or compatible PC may be obtained by sending a formatted disk (either 3.5 or 5.25 in.) to Donald A. Hantula, Department of Management and Information Systems, College of Business and Administration, St. Joseph's University, 5600 City Ave., Philadelphia, Pennsylvania 19131-1395.

Table 1
Program Listing

```
10  CLS
20  RANDOMIZE TIMER
30  INPUT "ENTER VI VALUE IN SECONDS ", v
40  INPUT "ENTER THE NUMBER OF STEPS ", n
50  INPUT "ENTER NAME OF OUTPUT FILE ", ff$
60  DIM rd(n)
70  DIM vi(n)
80  OPEN ff$ FOR OUTPUT AS 1
90  PRINT #1, "NUMBER OF STEPS: "; n, "MEAN VALUE IN SECONDS: "; v
100 FOR m = 1 TO n
110 IF m = n THEN vi(m) = v * (1 + LOG(n)): GOTO 130
120 vi(m) = v*(1+(LOG(n)) + (n−m)*(LOG(n−m)) − (n−m+1)*LOG(n−m+1))
130 order = INT((n * RND + 1))
140 IF rd(order) = 0 THEN rd(order) = vi(m) ELSE 130
150 NEXT m
160 FOR a = 1 TO n
170 PRINT #1, rd(a)
180 NEXT a
190 CLOSE #1
200 END
```

of reinforcement remains constant over any time horizon. To ensure that the probability of reinforcement remains constant, Fleshler and Hoffman developed an iterative equation that yields an appropriate progression of VI values for any given number of steps and mean interval values. The equation is

$$t_n = [-\log_e(1 - p)]^{-1} \cdot [1 + \log_e N + (N - n)\log_e(N - n) - (N - n + 1)\log_e(N - n + 1)], \quad (1)$$

where t_n is the nth value in the progression, N is the number of intervals, and $[-\log_e(1 - p)]^{-1}$ is the mean of the theoretical distribution of intervals or, for calculating purposes, the mean interval value in seconds.

Using Fleshler and Hoffman's (1962) equation to calculate VI values by hand is laborious. However, the simple BASIC program shown in Table 1 will calculate VI values according to the Fleshler and Hoffman equation. The program was developed because although there are both published (Chayer-Farrell & Freedman, 1987; Hale, Myerson, & Miezin, 1982) and commercially available programs that will generate VI values, these programs were developed to control laboratory experiments and may be too involved and cumbersome to use for the sole purpose of generating VI values for applied work.

The program shown in Table 1 is easy to use. It prompts the user to enter the number of steps in the VI schedule and the mean VI value in seconds. The VI values in seconds are written in random order to an ASCII file to be printed using either the DOS PRINT command or a word processing program. Each new run of the program will produce a different random order of the VI values. The program has been tested under QuickBASIC 4.5 and should run on any MS-DOS® (IBM-PC® compatible) computer using any BASIC language dialect.

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